Volume 3

SCOPE OF WORK

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B.1.1. INTRODUCTION

This is a tender for the selection of a submerged hollow fibers membrane filtration system for The Yarkon River Water Treatment Plant (WTP) to be supplied in two modes, referred hereafter as MODE 1 and MODE 2, as follows:

MODE 1: Continuous treated water production of 1,333 m^3/hr.

MODE 2: Continuous treated water production of 1,890 m^3/hr.

The Yarkon River water quality fluctuates at a very wide range, as detailed in the attached Appendix 1. The fluctuations are mainly seasonal, relating to the river flow rate due to rainfall and varying water temperature. The river water is basically a mixture of fresh groundwater and tertiary sanitary effluent.

The main sensitive pollutants - organic pollutants, turbidity, suspended solids, bacteria and algae count have been identified as season related. To ensure a stable and continuous operation of the UF membrane system, this tender specifies only submerged reinforced hollow fibers UF membranes, as well as requirements for pre-treatment stages, including fine screening and coagulation/flocculation processes.

Hence, requirements related to the design of a pre-treatment stage prior to the UF treatment stage are included in the tender.

B.1.2. TREATED WATER REQUIREMENTS

The principal objective of the WTP is to produce a stable flow of water for recreational gardening and unrestricted irrigation of crops. The Yarkon river treated water must comply with the related local regulations, as indicated in Table 1. This goal is to be accomplished by applying filtration technology using submerged reinforced hollow fiber UF membranes.

Table 1 below summarizes the required quality of the final product water from the WTP (UF effluent) prior to disinfection (by MWC).

The product water quality must be kept within the values, listed in Table 1, as long as the raw water TSS and turbidity values are lower than 120 ppm or 140 NTU, respectively. In case of higher values of turbidity or TSS, the feed to the WTP may be halted.

Table 1: Required Treated Water Quality of the WTP

Parameter	Units	Guaranteed Value	Analysis Frequency
Turbidity	NTU	< 1	On-Line
Removal of Fecal Coli (***)	log removal	≥ 4	2/week
pH		6.5 – 8.5	1/week

* Scheme of the Yarkon Treatment Facility (Figures 1&2 and Appendices 2&3)

(***) In cases the feed water Fecal coli is lower than 10^4 CFU, then the product quality shall average at CFU≤1.[1]

- The YTF includes three major systems, as displayed in Figure 1:
  - Seven Mills Pumping Station (SMPS).
  - Water Treatment Plant (WTP).
  - Irrigation Water Distribution Plant (IWDP).

[1] Clarification notice no.4 annex B item 3

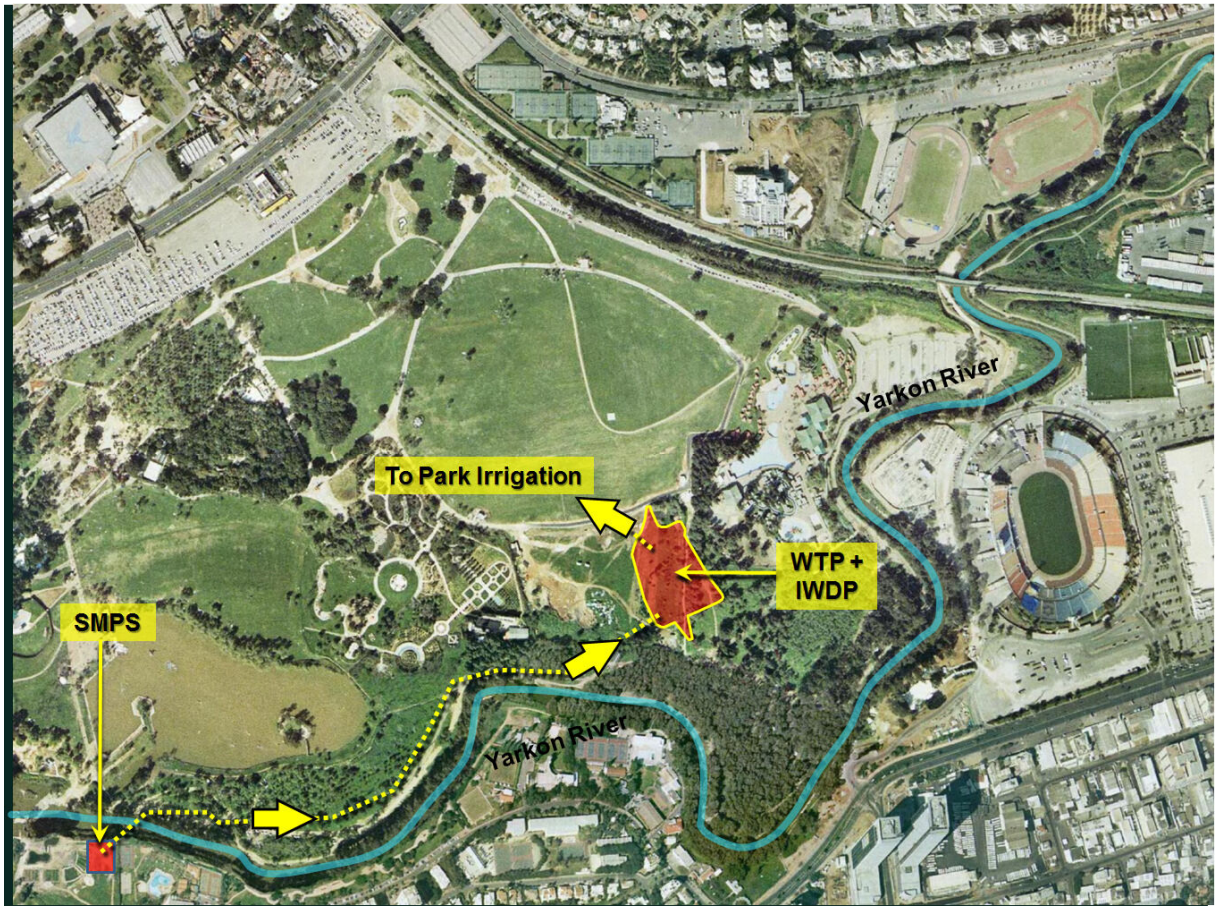

Figure 1: Water Treatment Array in The Yarkon Park.

- The SMPS discharges raw water from the Yarkon river to the WTP. The water is pre-filtered by a 6-mm coarse screen and then pumped to the WTP by three (3) identical VFD controlled submersible pumps in MODE 1 and by four (4) identical pumps in MODE 2. The Suppliers' scope of design starts at Tie Point (TP) 1, as illustrated in drawing 0367-TEC-04 (Appendix 3). The discharge flow rate of SMPS is designed as follows:
  - o MODE 1 - three (3) submersible pumps are capable of delivering a combined flow rate range of 1,432 to 1,577 m^3/hr and a head of 1.8 barg at TP1.
  - o MODE 2 - four (4) submersible pumps are capable of delivering a combined flow rate range of 2,030 to 2,237 m^3/hr with and a head of 1.6 barg at TP1.
- The WTP reduces TSS, turbidity and fecal coliforms in the raw water, as displayed in Figure 2, and discharges it to the IWDP through TP6 for disinfection and irrigation system discharge. The reject stream, produced at the WTP, is discharged to the Municipal Wastewater Treatment Plant (MWWTP) through TP5.

B.1.3. Process Description of the WTP (Figure 2 and Appendix 2)

- The raw water in **TP1** shall be pre-filtered by an automatic 500-micron (or less) filtration system (F-100) in either one or two consecutive filtrations steps to remove large solids and to reduce the TSS load on the downstream UF system.
- The pre-filter shall be automatically backwashed (based on differential pressure, timer or manually by the operator) by an external pump (P-101A/B), using its filtrate as the backwash medium. The reject shall be collected in the reject collection tank (TK-112) and then discharged to the MWWTP.
- The filtrate shall be fed to the coagulation/flocculation system, comprised of a flash mix tank (TK-100) for coagulation process, followed by flocculation tanks (TK-101A/B/C).
- Ferric chloride ($FeCl_3$) solution shall be injected to the flash mix feed line by a dosing pump (P-102A/B), as a coagulant/flocculant agent, maintaining a concentration of up to 7.5[2] mg/l as $FeCl_3$ in the feed line. The flash mix tank shall be rapidly mixed by a top-entry mixer.
- There is an option to dose hydrochloric acid (HCl) to the filtrate feed line for pH adjustment to provide the optimal pH range required for the flocculation process.
- From the flash mix tank, the water shall be divided equally between the three (3) flocculation tanks, designed with a retention time of 5 to 10 minutes, which is suitable for the formation of small flocs. Each flocculation tank shall be slowly mixed by a top-entry mixer.
- From the flocculation section, the floc containing water shall overflow and evenly distributed between the six (6) membrane tanks (TK-102A/B/C/D/E/F) through a distribution pipe.
- Each membrane tank shall contain immersed hollow fibers UF membrane units (F-101A/B/C/D/E/F), with a suitable filtration area for MODE 1 or 2 operation.
- A permeate pump (P-100A/B/C/D/E/F), one per each membrane tank, creates a vacuum in the collection header connected to each membrane cassette in the specific tank. The vacuum draws the treated water through the membrane lumens. The permeate is then discharged to the collection header and then to the IWDP through **TP6**.
- Prior to TP6, sodium hypochlorite solution shall be injected to the filtered water by a dosing pump (P-103D/E).

[2] Clarification notice no.4 annex B item 11

- Air shall be introduced to the bottom of each membrane cassette by four (3+1) blowers (B-100A/B/C/D), producing turbulence that scours the external surface of the fibers. This scouring action shears attached solids from the membrane fibers surface.
- In order to prevent blockage of the membrane fibers by suspended particles in the membrane tank, periodic backwashing is required. The backwash shall be done by an external pump P-111A/B (1+1) discharging permeate from the backwash tank (TK-103) to the permeate line of each membrane train. The backwash tank is filled from the common UF permeate collection line by an on/off valve).
- Periodic maintenance and recovery Cleaning in Place (CIP) with sodium hypochlorite and acidic solution are required to decrease organic and chemical fouling on the surface of the membrane fibers in order to recover the original permeability. The CIP is done in several steps:
    - Preparation of the cleaning solution in the designated tank – acidic solution CIP in TK-104A and hypochlorite CIP in TK-104B. Pump P-108A/B (1+1) is utilized for the mixing of the dosed acidic solution by dosing pump P-105A/B. Pump P-109A/B (1+1) is utilized for the mixing of the dosed hypochlorite solution by dosing pump P-103A/B/C.
    - Drainage of the specific membrane tank to the reject collection tank.
    - The cleaning solution is discharged to the membrane tank by P-108A/B (1+1) or P-109A/B (1+1) for acidic or hypochlorite cleaning, respectively.
    - After the soaking time has elapsed, the cleaning solution is pumped from the membrane train to the right CIP tank using the CIP pump and on/off valves alignment.
    - In the CIP tank the cleaning solution is neutralized:
        - acidic CIP using caustic soda dosing by pump P-107A/B and pH monitoring.
        - Hypochlorite CIP using SBS dosing by pump P-106A/B and total chlorine monitoring.
    - After the cleaning solution has been neutralized, it is discharged to the reject collection tank by the CIP pump. From the reject tank it is discharged to the MWWTP.
- During the filtration cycles, the TSS concentration in the membrane tank increases. In order to facilitate a steady UF performance (in terms of flux), the membrane tank has to be drained and backwashed periodically every few filtration cycles. The tank

is drained by gravity to the reject collection tank (TK-112), located underneath the membrane tanks by opening of an on/off valve.

- The reject overflows to the reject pumping station (TK-113) discharging it to the MWWTP collection system through **TP5** by three (3) submersible pumps (2+1) P-110A/B/C at a maximal flow rate of 300 m^3/hr. The reject quality is detailed in Table 3 below.
- The reject collection tank shall be designed with an emergency overflow to the Yarkon river through **TP4**.
- All concrete walls, which are **not marked in red** in drawing 0367-TEC-04, can't be changed and redesigned, so that the Suppliers' design scope includes only the red marked walls.
- The plant shall be designed to/from the following tie points:
  - **TP1:**
    - Description: Influent feed to the pre-filtration system.
    - IL: +7.60
    - Connection Flanges at Tie-point: Two flanges with nominal diameter of DN560.
    - Flow Rate Range in MODE 1: 1,432 to 1,577 m^3/hr.
    - Pressure Head in MODE 1: 1.9 barg
    - Flow Rate Range in MODE 2: 2,030 to 2,237 m^3/hr
    - Pressure Head in MODE 2: 1.7 barg
  - **TP2:**
    - Description: Tap water for maintenance and commissioning.
    - IL: +10.00
    - Available Pressure Head: 4-5 barg
    - Connection Flange at Tie-point: DN100, Crosslinked PE (PEX).
  - **TP3:**
    - Description: Sleeves for Ferric chloride ($FeCl_3$) and Sodium hypochlorite (NaOCl) dosing lines.
    - IL: +9.60
    - Details: 2 sleeves with a nominal diameter of 3".
  - **TP4:**
    - Description: Emergency overflow of reject to Yarkon river.
    - IL: +5.80
    - Connection Flange at Tie-point: DN500, HDPE with concrete coating.

- **TP5:**
  - Description: Reject discharge to MWWTP.
  - IL: +8.83
  - Required Pressure Head: 8 meters
  - Connection Flange at Tie-point: DN315, HDPE with concrete coating.
- **TP6:**
  - Description: Product water to IWDP.
  - IL: +7.88
  - Required Pressure Head: 10 meters
  - Connection Flange at Tie-point: HDPE with a nominal diameter of DN800.

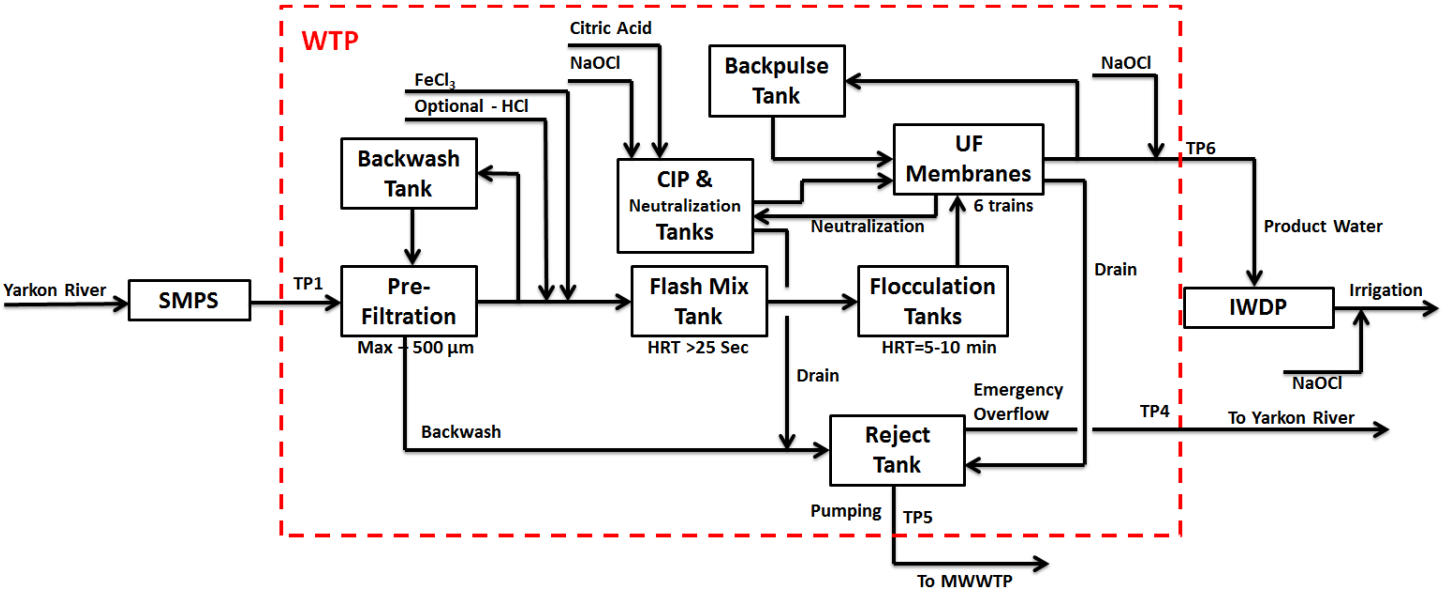

Figure 2: Basic Process Flow Diagram.

The WTP shall be fully automated, including the ability to operate the plant remotely.
The SMPS and the IWDP shall be connected to the WTPs' central PLC.
All data shall be transmitted to Mekorot Water Company (MWC) control center in Ramla and in Tel Aviv.

The raw water average and maximum characteristics in both seasons – winter and summer is detailed in Table 2 below. For additional characteristics (pH, alkalinity, etc.) please refer to Appendix 1.
These values were obtained from a 1-year sampling campaign.

Table 2: Design Values of Yarkon River Raw Water to The WTP

Parameter	Summer Average	Summer Peak	Winter Average	Winter Peak
Total Suspended Solids (mg/l)	50	90	60	120
Turbidity (NTU)	50	80	60	140
Algae Count (A/ml)	1,200	8,500	600	900
Temperature (°C)	25	30	20	13

Table 3: Maximum values for reject discahrge to the municipal sewer system

Parameter	Units	Max Value
Flow Rate	m^3/hr	300
Temp.	°C	40
pH	mg/l	6-10
TSS	mg/l	1,000
Free Chlorine	mg/l as Cl_2	0.5

B.1.4. **Site Data**

The WTP shall be located at the "Yaar Bereshit", Yarkon Park in Tel Aviv, Israel.

The climate is typical to Mediterranean zones and with high relative humidity.

Maximum Ambient Temperature: 40 ^{0}C. Minimum Temperature: 0 ^{0}C.

Relative Humidity: 40% to 80%.

SCOPE OF SUPPLY

B.1.5. Engineering Package- Contract Period

The Supplier shall provide documents at the after-award stage and after the commissioning site assessment (section B.1.26.4 in this volume). Table 4 specifies the required documents for each stage.

Table 4: Documents to be submitted by the Supplier

No.	Document/Drawing	After Award	Commissioning Site Assessment
1	Detailed process description	V	
2	Detailed process calculations	V	
3	Mass balance for all process streams, including waste and chemicals.	V	
4	Process flow diagram (PFD) including all equipment and instrumentation	V	
5	Piping and instrumentation diagrams (P&IDs)	V	V
6	Hydraulic profile	V	
7	2D layout with piping greater than 80 mm	V	V
8	3D layout with piping greater than 80 mm	V	V
9	General cross sections – 4 different sections	V	V
10	General isometric views – 4 different views	V	V
11	Isometric view for each process unit: pre-filtration, rapid mix and flocculation, UF membranes and chemical dosing stations.	V	V
12	Architectural drawings of each process unit, including penetrations scheme: • Pre-filtration system – Filter and its backwash tank. • Flash mix tank. • Flocculation tanks and its feed channel. • UF Membrane system – membrane tanks, backpulse tank, acidic CIP tank and hypo CIP tank. • Reject tank.	V	V
13	UF membranes cover details	V	
14	Piping isometrics	V	

No.	Document/Drawing	After Award	Commissioning Site Assessment
15	Bill of Quantity of all supplied equipment, incl. valves, check valves and pressure gauges.	V	
16	Instruments and motors installation points	V	
17	Equipment list	V	
18	Equipment data sheets	V	
19	Instrumentation list	V	
20	Instrument data sheets	V	
21	Motor list	V	
22	Line List	V	
23	Valve list	V	
24	Valve data sheets	V	
25	Single line diagram	V	
26	Control narrative (system philosophy)	V	V
27	Operation sequence chart (OSC)	V	V
28	Operation and maintenance manual (O&M)		V
29	I/O List	V	
30	Detailed commissioning plan and schedule	V	

Comments:

1. All drawings shall be in English language and all dimensions shall be in SI system. Symbols shall be in accordance with approved standards. All drawings shall conform to ISO paper sizes of A0 to A1.
2. The 2D, 3D, cross sections and isometric drawings (no. 7 to 10) shall include piping supports, service platforms and required electro-mechanical equipment concrete pads.
3. The piping isometrics (no. 14) shall include piping supports and concrete pad for the pumps.
4. The equipment list (no. 17) shall include the following information: tag name, description, type, design parameters, manufacturer, model, data sheet no. and rated power.
5. The instrumentation list (no. 19) shall include the following information: tag name, description, type, PLC signal, measurement range, output signal, model, manufacturer, data sheet no. and process connection.

6. The motor list (no. 21) shall include the following information: tag name, P&ID no., motor type, speed, insulation class, driven equipment, enclosure class, mounting, starter type, voltage, phase, frequency and rated power.
7. The valve list (no. 23) shall include the following information: tag name, P&ID no., fluid type, operating temp. and pressure, valve type, nominal diameter, rating, connection type, material of construction for the various parts and manufacturer. For the actuated valves please specify the type of actuator and its manufacturer.
8. The Supplier shall revise and update all drawings to "as-built" category with the installation completion of all piping, valves, instruments and all equipment items (after Commissioning Site Assessment). The control narrative (no. 26) and OSC (no. 27) shall be final revised at the end of the Commissioning Site assessment.
9. The Suppliers' scope of design includes ONLY the architectural design of the various process units (length, width, height, water depth and penetrations scheme as per no.12). The civil design is fixed and can't be changed except for the following: Adjustment of the membrane tanks width by up to 15 cm to either side is allowed. This means that only the walls, which are marked in red in drawing 0367-TEC-04, can be moved in accordance with the previous statement. The civil design shall be performed by MWC.
10. Underground piping, which are marked in blue in drawing 0367-TEC-04, are fixed and will be installed during the floor casting.
11. Mandatory tie-points (6 tie-points) which are laid down in drawing 0367-TEC-04 are fixed in the mentioned locations.
12. Provide five (5) hardcopies and three (3) softcopies for all drawings and documents submitted after the Commissioning Site assessment. All softcopies of the drawings shall be submitted in pdf and dwg (Autocad) format. All documents shall be submitted in open-for-edit format.

B.1.5.1. O&M Manual

- Provide five (5) hardcopies and three (3) softcopies of the WTP Operation and Maintenance Manual before the raw water performance test begins.
- Include the operation and maintenance information written by the Membrane System Supplier as well as a compilation of the equipment manuals for each piece of equipment provided as an element of the plant.
- At the minimum, include the following information in the Manual:
  - Description of the entire system.
  - Drawing list and Functional Design Specification.
  - Start-up procedures.

- Shutdown procedures under normal and emergency conditions.
- Standard operating procedures, including a sample daily operating log and laboratory procedures.
- System philosophy, including alarms, process control, and system efficiency and optimization considerations.
- Procedures to deal with one membrane train out of service.
- Troubleshooting.
- Maintenance, corrective, and preventative.
- Glossary of terms.
- Vendor contact list.
- Recommended spare parts inventory.
- Valve schedule for valves 25 mm in size and above.
- Safety.
- Operator SCADA Manual.
- Summary of equipment Suppliers with addresses and phone numbers.
- Emergency phone numbers, including that of the Membrane System Supplier representatives.

- As specified herein, include sections in the Manual to cover the following information for each component of the WTP:
  - Description of the component.
  - Disassembly and reassembly instructions.
  - Troubleshooting.
  - Maintenance, preventative and corrective.
  - Parts list including recommended spare parts.
  - Piping and instrumentation diagrams, including logic summary if applicable.
  - Electrical wiring schematic.
  - Accessory literature.
  - Safety.
- As specified herein, include Supplier equipment manuals for each component of the WTP, including, but not limited to, the following:
  - Pre-filtration including backwash system.
  - Membrane system.
  - Air scouring system.
  - Compressed air system.

- Permeate (product water) pumping/suction system.
- CIP cleaning system including chemical feed pumps and chemical storage facilities.
- Drain collection and discharge system.
- All instrumentation.

B.1.6. Main Process Units & Mechanical Scope of Supply

The Supplier shall design and supply the following items to be installed in the WTP:

- Pre-Filtration System:
  - One (1) fully automatic filtration system employing a nominal filtration grade of up to 500-micron. The filtration system can be designed as either one (1) or two (2) stage array, where the filtration grade of the 2nd stage must be up to 500-micron. This system shall be designed as plug&play unit, which include internal manifolds, actuated valves, isolation valves, check valves, pressure gauges and pressure transmitters. **The filtration system shall be supplied and designed for both modes of operation**.
  - Two (2) backwash pumps for external backwash of the filtration system (one duty and one standby), horizontal centrifugal, including valves, check valves and pressure gauge.
  - One (1) backwash tank TK-111 with a total volume of 10 m^3 (operating volume – 9.4 m^3), made of FRP.
- Flocculation System:
  - One (1) top-mounted mixer for the rapid mix tank.
  - Three (3) top-mounted mixers for the flocculation tanks - one for each tank.
  - Three (3) electrically operated[3] weir gates for the flocculation tanks – one per each tank.
- UF submerged reinforced hollow fibers membrane system including associated equipment in the six (6) designed membrane trains:
  - UF Membranes:
    - MODE 1: immersed UF membranes with a suitable filtration area for a net flux of 30 LMH and permeate flow rate of 250 m^3/hr per train, including at least 10% spare space.

[3] Clarification notice no.4 annex B item 11

- MODE 2: immersed UF membranes with a suitable filtration area for a net flux of 30 LMH and permeation flow rate of 355 m^3/hr per train, including at least 10% spare space.

- Membrane unit hanging supports, permeate collection and air distribution header pipes with valves per train.
- Four (4) Membrane air scour blowers – one for each of three membrane trains plus one standby. Each blower shall supply scouring air to two membrane trains. The fourth blower shall be designed as hot redundant to all three operation blowers.[4] All blowers shall be rotary lobe equipped with VFDs and the associated equipment – acoustic enclosure, inlet filter and silencers, pressure differential indicators, pressure safety valves, pressure gauges and check valves. The blowers shall be designed to provide the required air scour flow rate range for MODE 1 and 2.
- Six (6) permeate (effluent) pumps – one for each membrane train (P-100A/B/C/D/E/F).

  Each pump shall be designed to provide the required nominal permeation flow rate range for both MODE 1 and 2 operation, hence 250 to 355 m^3/hr.

  All pumps shall be horizontal centrifugal equipped with VFDs and include isolation valves, check valves and drain valves. The required pressure head at TP6 (connection of the product water line to external line heading to the contact tank) is **10 meters**.
- Two (2) backpulse pumps (one duty + one standby) designed to provide the required backpulse flow rate range for both MODE 1 and 2 operation.

  All pumps shall be horizontal centrifugal, equipped with VFDs and include isolation valves, check valves, drain valves and pressure gauges.
- Any Special Equipment required for unit access and removal including lifting devices and/or module removal tools.

- One (1) compressed air system – reciprocating compressor, including two reciprocation units (one duty + one standby) one receiver tank, one air dryer and one activated carbon adsorption unit, including all required instruments, as specified in section B.1.20 below.
- Six (6) chemical dosing stations, designed for both MODE 1 and 2 operation, including internal piping design:

[4] Clarification notice no.4 annex B item 13

- One (1) citric acid (50% w/w), or other approved acidic chemical, dosing skid for membrane system CIP (maintenance and recovery CIP), consists of:
  - 3 m^3 (working volume – 2.8 m^3) HDPE storage tank (according to MWC standard specification 721.001).
  - Three (3) dosing pumps (two duty + one standby) – P-104A/B/C. P-104A is for the maintenance CIP, P-104A+P-104B is for the recovery CIP and P-104C is standby for both maintenance and recovery cleans. All pumps shall be designed with integrated flow indication.
  - Calibration column, pulsation dumper (if needed), pressure gauge, valves and check valves.
- One (1) sodium hypochlorite (NaOCl 12% as Cl_2) dosing station consists of:
  - 30 m^3 (working volume – 25 m^3) PVDF reinforced FRP storage tank (according to MWC standard specification 711.009).
  - Three (3) sets of dosing pumps for membrane system CIP, product water disinfection and post-disinfection:
    - Three (3) dosing pumps (two duty + one standby) – P-103A/B/C. P-103A is for the maintenance CIP, P-103B is for the recovery CIP and P-103C is standby for both maintenance and recovery cleans. All pumps shall be designed with integrated flow indication.
    - Two (2) dosing pumps (one duty + one standby) P-103D/E for product water disinfection with integrated flow indication. Each pump shall be designed to deliver sodium hypochlorite solution at a flow rate range of 15 to 200 L/hr and a discharge head of 2 barg.
    - Two (2) dosing pumps (one duty + one standby) P-103F/G for irrigation water post-disinfection with integrated flow indication. Each pump shall be designed to deliver sodium hypochlorite solution at a flow rate range of 0 to 15 L/hr and a discharge head of 8 barg.
    - All of the abovementioned dosing pumps shall be mounted on one skid, consists of one calibration column, pulsation dumpers (where needed), anti-syphon (where needed), pressure gauges, valves and check valves.

- One (1) Ferric chloride ($FeCl_3$ 40% w/w) dosing skid for coagulation/flocculation, consists of:
  - 25 m^3 (working volume – 20 m^3) FRP storage tank (according to MWC standard specification 721.001).
  - Two (2) dosing pumps (one duty + one standby) – P-102A/B with integrated flow indication. Each pump shall be designed to deliver ferric chloride solution to the pre-filter filtrate line, maintaining a maximum concentration of 5 mg/l as $FeCl_3$.
  - The dosing pumps shall be mounted on one skid, consists of one calibration column, pulsation dumper (if needed), pressure gauge, valves and check valves.
- One (1) hydrochloric acid (HCl 33% w/w), or other approved acidic chemical, dosing skid for membranes CIP and an option for raw water pH correction, consists of:
  - 3 m^3 (working volume – 2.8 m^3) HDPE storage tank (according to MWC standard specification 721.001).
  - Two (2) dosing pumps (one duty + one standby) – P-105A/B with integrated flow indication.
  - The dosing pumps shall be mounted on one skid, consists of one calibration column, pulsation dumper (if needed), pressure gauge, valves and check valves.
- One (1) sodium bisulfite ($NaHSO_3$ 38% w/w) dosing skid for hypo CIP reject neutralization, consists of:
  - 3 m^3 (working volume – 2.8 m^3) HDPE storage tank.
  - Two dosing pumps (one duty + one standby) – P-106A/B with integrated flow indication. The maximum allowed free chlorine concentration in the discharged reject is 0.5 mg/l as Cl_2 according to Table 3.
  - The dosing pumps shall be mounted on one skid, consists of one calibration column, pulsation dumper (if needed), pressure gauge, valves and check valves.
- One (1) Caustic soda (NaOH 20% w/w) dosing skid for acidic CIP reject neutralization, consists of:
  - 3 m^3 (working volume – 2.8 m^3) PP storage tank (according to MWC standard specification 721.001).

  - Two dosing pumps (one duty + one standby) – P-107A/B with integrated flow indication. The lowest allowed pH for the reject disposal is 6, according to table 3.
  - The dosing pumps shall be mounted on one skid, consists of one calibration column, pulsation dumper (if needed), pressure gauge, valves and check valves.

- Three (3) reject discharge pumps (two duty + one standby) for waste discharge from the reject pumping station to the municipal sewage system. The pumps shall be submersible with a flow rate of 150 m^3/hr each. The system shall include valves, check valves and pressure gauges. The minimal required head at TP 5 (connection to sewer discharge line) is **8 meters**.
- Equipment for the acidic CIP system:
  - Two (2) horizontal centrifugal CIP pumps (one duty + one standby) P-108A/B for acidic solution feed to membrane tanks.
- Equipment for the hypo CIP system:
  - Two (2) horizontal centrifugal CIP pumps (one duty + one standby) P-109A/B for sodium hypochlorite solution feed to membrane tanks.
- Sampling valves where applicable (shall be defined by MWC).
- The following instruments:
  - One (1) flow transmitter on the raw water feed line. It shall be sized for both MODE 1 and 2 operation.
  - One (1) turbidity transmitter on the raw water feed line.
  - One (1) pH and temperature transmitter (combined) on the raw water feed line.
  - One (1) conductivity transmitter on the raw water feed line.
  - One (1) pH transmitter in the flash mix tank (TK-100).
  - One (1) turbidity transmitter on the membrane distribution pipe.
  - One (1) level transmitter on the pre-filter backwash tank (TK-114).
  - One (1) level transmitter in each membrane tank. A total of six (6) level transmitters shall be supplied.
  - Two (2) level switches (low and low-low) in each membrane tank. A total of twelve (12) level switches shall be supplied.
  - One (1) Pressure transmitter on the permeate suction line of each permeate pump. A total of six (6) pressure transmitters shall be supplied.
  - One (1) Pressure switch high on the permeate suction line of each permeate pump. A total of six (6) pressure switches shall be supplied.

- One (1) Vacuum ejector on the discharge line of each permeate pump. A total of six (6) Vacuum ejectors shall be supplied.
- One (1) flow transmitter on the permeate discharge line of each permeate pump. A total of six (6) flow transmitters shall be supplied. It shall be sized for both MODE 1 and 2 operation.
- One (1) Pressure transmitter on the permeate discharge line of each permeate pump. A total of six (6) pressure transmitters shall be supplied.
- One (1) turbidity transmitter on the permeate discharge line of each permeate pump. A total of six (6) turbidity transmitters shall be supplied.
- One (1) temperature transmitter on the common header of the permeate discharge line.
- One (1) level transmitter in the UF backwash tank.
- One (1) flow transmitter on the discharge line of the UF backwash pumps (P-111A/B). It shall be sized for both MODE 1 and 2 operation.
- One (1) level transmitter in every CIP tank (TK-104A/B) – A total of two (2) level transmitters shall be supplied.
- One (1) flow transmitter on the discharge line of the reject pumps (P-110) to the municipal sewage.
- One (1) pH transmitter on the discharge line of the acidic CIP pump (P-108).
- One (1) pH transmitter on the discharge line of the hypo CIP pump (P-109).
- One (1) total chlorine transmitter on the discharge line of the hypo CIP pump (P-109).
- One (1) level transmitter in the sodium hypochlorite tank (TK-105).
- One (1) level transmitter in the ferric chloride tank (TK-110).
- One (1) level transmitter in the reject collection tank (TK-112).
- One (1) total chlorine analyzer in the IWDP contact tank. A detailed location of installation shall be provided on the award stage.
- Two (2) total chlorine analyzers on the irrigation discharge pipe. A detailed location of installation shall be provided on the award stage.

B.1.7. **Concrete Tanks Lining (by MWC)**

- The wetted surface of the following concrete tanks shall be protected against possible corrosion by T-ribbed flexible HDPE lining plates, cast into the concrete walls:
  - Flash Mix tank
  - Flocculation tanks

- Membrane tanks
- CIP tanks
- Backwash tank

The reject collection tank shall be coated according to MWC specs.

- The design and execution of the lining system, or the approved protection, shall be carried out by MWC.

B.1.8. Process Equipment Description

- All systems/equipment under MWC scope of design & supply shall be marked hereunder.

B.1.8.1. Seven Mills Pumping Station (SMPS) – By MWC

- The SMPS is designed to pump water from the Yarkon river and discharge it to the WTP, located about 1,000 meters west to the WTP.
- The pumping station is equipped with three (2+1) submersible pumps in MODE 1 and with four (3+1) pumps in MODE 2. Each pump is designed to deliver raw water at a flow rate of 542 m3/hr and head of 27 m.
- In MODE 1 normal operation, the pumping station is designed to deliver raw water at a flow rate range of 1,432 to 1,577 m3/hr, accounting for the minimum and maximum allowed recovery of the WTP, as detailed in the following sections B.1.13 and B.1.14.
- In MODE 2 normal operation, the pumping station is designed to deliver raw water at a flow rate range of 2,030 to 2,237 m^3/hr.
- In both modes of operation, the minimal provided pressure head at TP1 shall be **15 meters**.
- The pumping station is also equipped with a 6-mm coarse screen.
- The rivers' water level is continuously monitored by an ultrasonic level transmitter, installed in the pumping station. In cases of low water levels, the pumping flow rates shall be decreased by automatic shut-down of the pumps.

B.1.8.2. Pre-Filtration System

The pre-filtration system, located downstream of the pumping station and upstream of the membrane system, shall remove fine particles, entrained in the raw water and be designed with the following parameters:

- Filter Type: automatic disk or screen filter.
- Filtration Capacity: MODE 1 and 2, meaning a flow rate range of 1,432 to 2,237 m^3/hr at the filters' inlet.

- Filtration grade: the filtration grade shall be <500 micron and according to the membrane Supplier's instructions by one or two screening steps, in order to meet the Supplier's membrane warranty provisions.
- Pressure Drop: The system shall be designed with maximum pressure drop of 8 meters.
- Backwash: The system shall be designed with an automatic external backwash system comprised of 10 m^3 PE backwash tank (TK-114) and two (2) dedicated backwash pumps (one duty + one standby). The pump shall be designed with sufficient flowrate and head for the proper backwash of the filtration system. The backwash tank shall be filled with the filters' product water by opening of an actuated valve. The backwash sequence shall be initiated based on pressure drop across the filter, by timer or manually by the operator. The backwash water shall be discharged (after the filter) to the reject drain tank (TK-112) and from there to the municipal sewage system by reject discharge pump P-110.

The primary function of the pre-filtration system is to protect the sensitive UF membrane fibers from being raptured by coarse particles in the raw water.

B.1.8.3. Coagulation/Flocculation System

In order to optimize the membrane separation performance, a coagulation flocculation process must be employed upstream using a coagulation agent (ferric chloride). There is an option to add an acidic solution (HCl) to provide the optimal pH range for this process.

The system shall be comprised of flash mix tank, where the injected coagulant will be properly dissolved, and three (3) parallel flocculation tanks, where fine flocs will be formed from the colloidal suspended particles.

- Coagulant/Flocculant Dosing: Ferric Chloride (40% w/w) shall be dosed to the pre-filter filtrate line at a concentration of up to 5.0 mg/l as $FeCl_3$. The dosing pumps' flow rate shall be automatically regulated according to flow measured at the inlet. The dosing shall be done by fully two (2) automatic dosing pumps (one duty + one stand-by), designed for both MODE 1 and 2 operation, with automatic transfer between the operating and the stand-by one.
- Flash Mix Tank: The filters' product water shall be discharged to a completely mixed tank. The tank shall be designed with sufficient volume for MODE 2 with a minimal hydraulic retention time of 25 seconds. The tank shall be made out of concrete and built by MWC. The tank shall be rapid mixed by a top-entry mixer.

- Flocculation Tanks: The water will overflow from the flash mix tank to the flocculation tanks distribution pipe, where it will be split evenly between the three identical flocculation tanks by gravitation overflow. The overflow openings from the flash mix tank shall include electrically operated sluice gates (one per flocculation tank) to allow the flexible operation of this system, with regards to retention times, in various feed flow rates. The flocculation tanks shall be designed with sufficient volume for retention time of 5 to 10 minutes in MODE 2. The tanks shall be made out of concrete and built by MWC. Each tank shall be slowly mixed by a top-entry mixer.

B.1.8.4. Membrane Tanks

- The coagulated water shall be introduced to the membrane tanks by gravity through a distribution pipe, equipped with on/off control valves at the feed of each one of the six trains. There will be six (6) parallel membrane trains in MODE 1 and 2 operation.
- The supplied UF membranes shall comply with the following parameters for each mode of operation:
    - MODE 1: immersed UF membranes with a suitable filtration area for an average flux of 30 LMH and a flow rate of 250 m^3/hr per train, including at least 10% spare space.
    - MODE 2: immersed UF membranes with a suitable filtration area for an average flux of 30 LMH and a flow rate of 355 m^3/hr per train, including at least 10% spare space.

The employed UF membrane system shall be comprised of a submerged reinforced hollow fiber membrane type, operating under low-pressure vacuum conditions. Each filtration cycle includes two consecutive steps - permeation followed by backwash. Permeation refers to the period of time when treated water is drawn through the membrane fibers by vacuum and is pumped through the permeate piping for its ultimate end-use. During membrane backwash, filtered water from the membrane backwash tank is passed from the inside to the outside of the membrane to disrupt any particles that may be physically lodged in the membrane interstices. As water is pulled through the membrane during permeation, solids are left behind and the membrane tank becomes ever-increasingly concentrated. It is thus necessary to control this concentration by rejecting all water from the tank to the reject drain tank (TK-112), located underneath it.

B.1.8.5. Permeate pumps

The membrane cassettes in each tank shall be connected to a common permeate header, which in turn is connected to the suction of a horizontal centrifugal permeate pump. This set of cassettes, piping, and pump is referred to as a membrane train. The vacuum, generated by the pump, draws permeate from the outside-in through the membrane fibers.

All permeate pumps shall discharge the product water into a common discharge header. Each of the six (6) supplied permeate pumps shall be designed for an average permeation flow rate of 250 to 355 m^3/hr and a minimal head of 10 meters at TP6, taking into account **both modes of operation**. All permeate pumps shall be equipped with VFDs to allow for increases/decreases in permeate production depending on flow demands. The VFD will be controlled by an electromagnetic flow transmitter, installed at each pumps' discharge. A turbidity analyzer shall be installed at the discharge line of each train for continuous monitoring of each trains' performance. Furthermore, each train shall include pressure and temperature transmitters at the suction line of the permeate pump for TMP and permeability monitoring.

B.1.8.6. Product Water Disinfection and Post-Disinfection

- The produced permeate of the UF membrane system is required to be disinfected in order to comply with the local health regulations. According to the regulation, a contact time of 30 minutes and a residual chlorine concentration of 1 mg/l are required for both modes of operation.
- The irrigation water, pumped from the storage basin, has to be post-disinfected to comply with a discharge residual chlorine concentration of 0.5 mg/l.
- The disinfection process shall be performed using the sodium hypochlorite solution (12% as Cl_2) dosing system (P-103D/E), provided by the Supplier. The dosing rate shall be controlled by a total chlorine analyzer, located at the end of the contact tank, and provided by the Supplier.
- Each disinfection pump (1+1) shall be designed to provide a flow rate range of 15 to 200 L/hr in order to address both modes of operation with varying recoveries and a wide range of soluble oxidable contaminants in the raw water, such as BOD.
- The connection between the disinfection dosing system to the injection port, within the WTP, and the design of the injection system shall be done by MWC.
- The post-disinfection process shall be performed using the sodium hypochlorite solution (12% as Cl_2) dosing system (P-103F/G), provided by the Supplier. The dosing

rate shall be controlled by two total chlorine analyzers, located before and after the injection port, and provided by the Supplier.

- Each post disinfection pump (1+1) shall be designed to provide a flow rate range of 0 to 15 L/hr in order to address a wide range of irrigation water supply flow rates in MODE 1 and 2.
- The connection between the post-disinfection dosing system to the injection port, on the irrigation water discharge pipe, and the design of the injection system shall be done by MWC.
- MWC shall be held responsible for the performance and process guarantee for the disinfection and post-disinfection processes.

B.1.8.7. Membranes Backwash

All the membrane trains shall be operated with a repeating filtration cycle, consists of two steps: permeation (drawing) of water through the membranes followed by a short period of external reverse flow (Backwash). Only one train at a time will be backwashed.

Backwashing involves reversing flow through the membrane fibers to slightly expand the pores and dislodge any particles that may have adhered to the membrane fiber surface.

Under certain fouling conditions, the ability to backwash is essential to maintain a clean membrane and remove reversible fouling agents. This feature allows for flexible, reliable system performance during normal operation.

The backwash operation shall be achieved by isolating the certain train and using an external centrifugal pump (P-111A/B) to backwash the membrane sieves. The backwash pump (one duty + one standby) shall be horizontal centrifugal with VFD operation by flow transmitter. The pump shall be designed to operate in both modes of operation. The pumps shall draw water from the backwash tank and discharge it to a common header, connected to the permeate line of each train.

B.1.8.8. Cleaning in Place (CIP)

CIP of immersed membrane is required to restore the permeability of the membrane fibers, which declines during regular operation due to irreversible fouling. This system has two types of operation:

- Maintenance CIP – the membrane fibers are soaked in hypochlorite and citric acid solutions frequently (once every day or week) for a short period of time.

- Recovery CIP – the membrane fibers are soaked in hypochlorite and citric acid solutions less frequently (once every month) for a longer period of time.

The UF membrane system CIP shall be comprised of two systems – acidic CIP and hypo CIP to remove two types of irreversible fouling sources – chemical and biological respectively.

The acidic CIP system is required to remove chemical reversible fouling from the membrane fibers by using a combination of citric acid and hydrochloric acid. The system shall be comprised of:

- CIP tank (TK-104A) with sufficient work volume to fill the membrane tank.
-
- A combination of citric acid and hydrochloric acid dosing, as specified in the Scope of Supply, section B.1.7.

The hypo CIP system is required to remove biological reversible fouling from the membrane fibers through the use of sodium hypochlorite solution. The system shall be comprised of:

- CIP tank (TK-104B) with sufficient work volume to fill the membrane tank.
- Sodium hypochlorite dosing system, as specified in section B.1.6.10.

The CIP system shall be operated as follows:

- The specific membrane tank is isolated and drained to the reject tank by on/off valves alignment.
- The CIP tank (acidic or hypo) is filled with product water from the backwash tank (TK-103) using the CIP pump (P-108 or P-109) and the correct on/off valve alignment.
- The CIP pump is then switched to internal recirculation mode of operation, where the cleaning solution (NaOCl or citric acid & HCl) is injected to the discharge line of the pump. The switching is achieved using the correct on/off valve alignment.. In the case of citric acid CIP, the pH of the solution is measured in the recirculation line. In the other case (hypo CIP), the pH and free chlorine concentration are measured in the recirculation line.
- Once the cleaning solution is ready, the on/off valves are aligned and the cleaning solution is discharged directly to the specific membrane train by the CIP pump.
- The membrane cassettes in the train are soaked in the cleaning solution for the required period of time. Afterwards, the on/off valves are aligned and the cleaning solution is pumped back to the correct CIP tank by the CIP pump for neutralization.

- The CIP pump is then switched to internal recirculation mode of operation, where the neutralization solution (NaOH or SBS) is injected to the discharge line of the pump. The switching is achieved using the correct on/off valve alignment.. In the case of citric acid CIP, the neutralized solutions' pH is measured in the recirculation line. In the other case (hypo CIP), the neutralized solutions' free chlorine concentration is measured in the recirculation line.
- Once the CIP solution is properly neutralized, the on/off valves are aligned and the solution is drained to the reject tank (TK-112).

B.1.8.9. Membrane Air Scour Blowers

Air scouring is another method to clean the membranes. The generated air bubbles create tremendous shear forces that scour the membrane surface from attached particles. The air scour system shall include:

- Four (4) blowers (3 duty + 1 standby) shall provide air scour to the UF membrane trains.
- Each blower shall provide air scouring to two UF membrane trains.
- The blower shall be capable of providing a wide range of continuous airflow to the membrane trains – from MODE 1 operation to full membrane population.
- Each blower shall be operated with VFD to regulate the required air flow based on the installed membrane filtration area.
- The standby blower shall be able to replace any of the three duty blowers in case of malfunction.
- The manifold of each blower shall deliver air to the membrane distribution air header installed above each membrane tank.

B.1.8.10. Reject Drain

- In order to facilitate a steady UF performance (in terms of flux), the membrane tank has to be drained and backwashed periodically every few filtration cycles. Once a backwash sequence is initiated, the permeation stops, the membrane tank is isolated (by closing the inlet on/off valve) and gravitationally drained to the reject drain tank (TK-112), located underneath, by opening the reject drain on/off valve.
- The reject overflows to the reject pumping station, equipped with three (3) submersible pumps (two duty + one standby) for a flow rate of 150 m^3/hr and a minimal head of 8 meters at TP 5.

- The reject is discharged to the municipal sewer collection system by the on/off submersible pumps, operated by a signal from a hydrostatic level transmitter installed in the pumping station.
- Drain streams containing chemical waste from membrane cleaning procedures shall be neutralized in the proper CIP tank (hypo or acidic) to be compatible with the standards depicted in table 3, and then discharged to the reject drain tank.
- The reject tank has to be designed with an emergency overflow, which shall be connected to a main line going back to Yarkon river. The Supplier has to design the emergency overflow pipe till TP 4.

B.1.8.11. Chemicals Dosing Systems

The WTP shall include six (6) dosing systems for six chemicals as follows:

- Ferric Chloride ($FeCl_3$ 40%) – one storage tank of 20 m^3 and 2 dosing pumps (one duty + one standby). It serves as coagulant/flocculant and injected to the pre-filter discharge line prior to the flash mix tank.
- Hydrochloric Acid (HCl 33%) – One dosing skid comprised of one storage tank of 3 m^3 and two dosing pumps (one duty + one standby). It serves as an acidic cleaning chemical for chemical fouling removal during the membranes CIP, combined with citric acid addition.
- Sodium Hypochlorite (NaOCl 12% as Cl_2) – one storage tank of 25 m^3 and three sets of dosing pumps – one for the membrane system biological fouling CIP (maintenance + recovery CIP), one for disinfection of the product water and the third for post-disinfection of the irrigation water.
- Citric acid (50%) – One dosing skid comprised of one storage tank of 3 m^3 and three dosing pumps (two duty + one standby). It serves the membrane system acidic CIP system. The citric acid is used as cleaning solution for chemical fouling in the membrane system. One pump is used for the maintenance CIP, two pumps for the recovery CIP and the third one as standby.
- Sodium bi-sulfite ($NaHSO_3$ 38%) – One dosing skid comprised of one storage tank of 3 m^3 and two dosing pumps (one duty + one standby). The SBS solution is used as reducing agent for any chlorine residuals left after the hypo CIP process. The maximum allowed free chlorine concentration in the reject, disposed to the sewer, is 0.5 mg/l as Cl_2.
- Sodium Hydroxide (NaOH 20%) – One dosing skid comprised of one storage tank of 3 m3 and two dosing pumps (one duty + one standby). The NaOH solution is used

for pH neutralization after acidic CIP process. The allowed range of pH for the reject discharge to the sewer is 6-10.

B.1.8.12. UF System Functional Operating Description & System Control

The UF system shall incorporate a high level of automation to enable easy and operator friendly plant operations. The system shall include a high level of operator overrides and manual operational capability. This combination will provide a highly flexible operating system. The control system shall look after all operating sequences and routine operations (such as routine cleans) so operators are free to monitor and provide value added services. The operating setting can be modified at the HMI by the operator. Should a specific operation be needed outside of the scheduled time, such as intensive clean, the operator can initiate the procedure by tapping the appropriate button on the HMI screen. The control system will start the sequence at the next logical step in the program and automatically complete it. Under normal operation, trains will automatically cycle between Permeation mode and Backwash events. The membranes may be backwashed and aerated every 20-40 minutes in between backwashes to maintain reasonable operating TMPs. If a condition arises that requires the train to temporarily halt production, the train will be automatically placed in Stand-by mode. When the overriding condition is cleared by the program or operator, the train automatically resumes the production cycle. If power is lost for some reason, trains will automatically resume production (or whichever mode they were in before the power loss) on restoration of power.

Flow of treated water through the system will be regulated according to the water level in the downstream product water storage basin and by the level in the membrane tanks. Individual membrane trains will start up in response to the demands of the system. The permeate flow through each membrane train will be adjusted utilizing variable frequency drive controllers on the pump motors, however, in order to maintain operational efficiency, each train should be operated at close to its nominal design capacity.

To prevent the problems associated with air locks in the piping and pump system (which may cause the permeate pump to lose its prime), an air removal system will be incorporated into the Membrane Filtration System.

The clarity of the treated water from each train will be monitored continuously by turbidimeters. To protect the integrity of the reservoir water and also to maintain the long-term operating performance of the membrane system, in the event of high turbidity the affected process stream will be shut down.

B.1.9. Control and Instrumentation

The following items shall be supplied by MWC:

- PLC
- All the required software.
- Human machine interface (HMI) in the Control room (PC, Printer, Modems, etc.).
- The PCs shall be hot redundant.
- Data Highway.
- The required hardware to enable interconnection with the MWCs' SCADA system.
- Historic operational data files.
- All necessary auxiliaries.

B.1.10. Spare Parts

The Supplier shall provide all spare parts, listed in Table 6 below, at his own expense. These spare parts are necessary to increase the reliability of the plant throughout the entire warranty period by preventing down time due to parts not being immediately available.

All spare parts shall be stored in a dedicated warehouse located in the WTP area, according to the manufacturers' instructions. All spare parts, listed in Table 6, shall be restocked at the Supplier's expense throughout the warranty period.

Table 6: Spare Parts List

	Quantity	Comment
Electromechanical Equipment		
Mechanical seal for Pre-Filtration Backwash Pump P-101	1	
Mechanical seal for Permeate Pump P-100	1	
Mechanical seal for Reject Discharge Pump P-110	1	
Mechanical seal for UF Backwash Pump P-111	1	
Ferric Chloride Dosing Pump P-102	1	
Seals set for Ferric Chloride Dosing Pump P-102	1	
Seals set for Hypochlorite Maintenance Clean Dosing Pump P-103A	1	
Seals set for Hypochlorite Disinfection Dosing Pump P-103D/E	1	

	Quantity	Comment
Seals set for Hypochlorite Post-Disinfection Dosing Pump P-103F/G	1	
Seals set for Citric Acid Maintenance Clean Dosing Pump P-104A	1	
Seals set for Hydrochloric Acid Dosing Pump P-105A	1	
Seals set for SBS Dosing Pump P-106A	1	
Seals set for Sodium Hydroxide Dosing Pump P-107A	1	
Valves & Fittings		
Check valve	1	1 unit shall be provided for each type of installed check valve
Actuated valve	1	1 unit shall be provided for each type of installed actuated valve
Manual valve	1	1 unit shall be provided for each type of installed manual valve
Instruments		
Turbidity Analyzer for raw water	1	
Turbidity Analyzer for product water	1	
Total Chlorine Analyzer	1	
pH Transmitter	1	
Ultrasonic Level Transmitter	1	
Immersed Hydrostatic Level Transmitter	1	
DP Level Transmitter	1	
Pressure transmitter	1	
Motors		
Pump Motor	1	1 unit shall be provided for each type of installed process pump
UF Membranes Kit		
UF membranes modules	[5]10	
Safety hoist ring	2	
EPDM O-ring - Top permeate saddle adaptor outer	100	

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	Quantity	Comment
EPDM O-ring - Top permeate saddle adaptor inner	100	
EPDM O-ring - permeate pipe	100	
EPDM O-ring - Module and dummy header	100	
Fibre repair kit	2	
Dummy header set	20	
Single module permeate adaptor for bubble test	5	

B.1.11. Piping & Valves

B.1.11.1. Piping

The Supplier shall deliver the following piping and fittings:

All piping and connections within the limits of the **membrane tanks** including only the permeate headers and air scouring headers on top of the membrane tanks.

- **Membranes Manifold Header Pipework:**
  - All steel manifold pipework shall be manufactured from stainless steel 316.
  - All valves and fittings located within the steel manifold pipework shall be manufactured from stainless steel 316 and compatible with the pipework material.
  - All air scour pipework shall be manufactured from stainless steel 316.

- **Air Piping**
  - The membranes air scour piping, from the blowers to the header above the membrane tanks, shall be made of stainless steel 316.

- **Interconnecting Piping and fittings**

  All other piping, within the boundaries of the WTP shall be designed by the Supplier and supplied by MWC.

  - All water piping, except the membrane permeate and air scour piping, **below** nominal diameter of DN500 shall be made of polypropylene (PP) PN10 (SDR11) with UV additive. Maximum flow speed shall be 1.5 m/s.
  - All water piping, except the membrane permeate and air scour piping, **above** nominal diameter of DN500 shall be made of polypropylene (PP) PN6 (SDR 17). Maximum flow speed shall be 1.5 m/s.

- The blowers piping shall be made of stainless steel 316L.
- The compressed air piping shall be made of stainless steel 316L.

B.1.11.2. Manual & Actuated Valves

The Supplier shall provide **all** manual and actuated valves.

All actuated valves equal or greater than DN250 or 10" shall be equipped with an electrical actuator. The rest of the actuated valves shall be equipped with a pneumatic actuator.

GENERAL TECHNICAL REQUIREMENTS

The design should maximize in-plant standardization. Standard items of equipment, such as pumps, motors, instruments, controls, electrical, etc., should be as much as possible from the same Supplier.

It is mandatory that these Suppliers have a representative in Israel capable of ensuring easy access to spare parts.

For all equipment supplied loose with flange connections, flanges will conform to ISO/DIN standards.

For all types of equipment or instruments, only equipment Suppliers which are approved for use in MWC plants will be allowed, (applicable where such standardization exists). MWC will supply a list of approved manufacturers/vendors per type with the Tender documents.

The Supplier shall be required to provide the names and addresses of these representatives.

B.1.12. Pre-Filtration System

The pre-filter shall be designed to operate in MODE 1 & 2 flow rate, with maximum differential pressure head of **8 meters** and a recovery ratio of **96 to 99%**.

Note: The raw water is characterized with high concentrations of mineral turbidity, especially after rain storms, as detailed in Appendix 1.

B.1.13. UF Membrane System

B.1.13.1. Designed Product Flow Rate

The UF system shall be designed to deliver the following performance in MODE 1 and 2:

Table 5: UF system performance requirements

Parameter	Mode 1	Mode 2	Units
Average Annual Permeate Flow Rate	10,000,000	14,000,000	m^3/year
Daily Permeate Flow Rate *	32,000	45,400	m^3/day
Net Hourly Permeate Flow Rate*	1,333	1,890	m^3/hr
Recovery*	88-94	88-94	%
Net Flux*	30	30	LMH

*As calculated on a daily average basis.

B.1.13.2. UF System Recovery Ratios

The required membrane system recovery (i.e. percent of feed water downstream the pre-filtration system that becomes product water) depends on the raw water turbidity values as follows:

- Between 20 to 140 NTU: The UF system recovery shall be 88%-94%.
- During N-1 condition (design flow rate and one membrane train is out of service): The UF system recovery shall be operated in the range of 88% to 94% for a timeframe of 24 consecutive hours with the same conditions per train, as defined in Table 5 above.
- Greater than 140 NTU: The raw water feed to the plant will be stopped.

B.1.13.3. Process Redundancy

- Each membrane train shall have a minimum of 10% spare space as blank spaces within the installed unit.

B.1.13.4. Design Flux

- The net design flux shall be 30 LMH for all six trains in operation.
- The plant shall be designed to operate with one train out of service (N-1) for a timeframe of 24 consecutive hours with the same conditions per train, as defined in Table 5.

B.1.13.5. Operating Environment

- The membranes shall be installed in tanks, constructed by MWC, of reinforced cast in-place concrete.
- The membrane tanks shall be covered with removable covers, approved by MWC.

B.1.13.6. Quality Control

- Membranes, modules and units must be manufactured in facilities that are ISO 9001 certified.

B.1.13.7. Membrane Fibers

- Permeate shall flow from outside to the inside of the membrane sieves (outside-inside filtration).
- The UF membranes shall have a maximum pore size of 0.1 µm.
- The membrane fibers shall be reinforced.
- Membranes shall be constructed of chemically resistant materials, such as PVDF.
- Membranes shall be capable of being washed in acidic solutions with a pH as low as 2.

- The membranes shall be guaranteed for a minimum cumulative NaOCl exposure of 500,000 ppm-hours over its lifetime.

B.1.13.8. Membrane Units

- Each unit shall be supported with a structure manufactured from stainless steel type 316L.
- Each unit shall be fitted with lifting lugs (at least one at each end) to allow the entire membrane unit to be lifted into and out of the membrane tank and transported away from it.

B.1.13.9. Membrane Tanks

- Provide all equipment to assemble the membrane units within each tank, including: permeate piping, air scouring piping and membrane support structure.
- Tanks will be cast in-place by MWC.
- Provide isolation valves of permeate and air scour pipes for each train in order to disconnect a specific membrane train from the system.
- Each tank shall have the ability to go off-line from the rest of the system to allow for maintenance or in-situ recovery cleanings.

B.1.13.10. Permeate System Piping

- Each membrane train shall have a permeate collection header.
- Connect all units in each membrane train to the permeate header.
- Each membrane train shall be in a separate, isolatable tank (by valves).
- The pipe connections between the membrane units and the permeate header shall be capable of withstanding positive and negative pressures expected for the system (permeation and backwash).

B.1.13.11. Chemical Cleaning System

- Chemical cleaning shall be fully automatic.
- Initiation of the chemical cleaning process shall by either by a scheduled event from the PLC or SCADA system, or by an operator-initiated command at the HMI.
- No operator intervention shall be required during the chemical cleaning process.
- Upon completion of the cleaning process, the system shall automatically return to normal operation.

B.1.13.12. Permeate and Air Scour Piping

- Provide all piping within the internal limits of the Membrane Tank.
- Terminate all piping with ISO/DIN standard flanges.

- The UF permeate header, unit connections and air scour header shall be made of stainless steel 316L.

B.1.14. Process Pumps

- All process pumps shall be ISO/DIN centrifugal with electric motor.
- All pumps shall be designed for continuous duty and shall operate in the maximum efficiency range. The motors shall be sized in such a way that they will not be overloaded at any point on the head capacity curve.
- VFD operated pumps shall be sized so that an increase of 10% in the flow rate will be achievable.
- The supplied process pumps shall comply with the following specifications:

Parameter	Details
Pump Tag Name	**P-100A/B/C/D/E/F, P-101A/B**
Type	Centrifugal Horizontal
Flanges Standard	ISO/DIN PN 16
Minimal Efficiency	75%
Casing (wetted part) MOC	SS316L
Impeller Type	Closed
Impeller MOC	SS316L
Shaft/Sleeve MOC	SS316L
Wear Ring MOC	SS316L
Bearings Lubrication	Grease
Mechanical Seal	Single, Silicon/Silicon Spring – Hastelloy C Elastomer – Viton Screws – SS316L
O-ring MOC	Viton
Base Plate MOC	Cast Iron
Base Plate Coating	Roasted Epoxy
Coupling	Elastomer with spacer
Motor	See Section B.1.16 below

Parameter	Details
Pump Tag Name	**P-108A/B, P-109A/B**
Type	Centrifugal Horizontal

Parameter	Details
Flanges Standard	ISO/DIN PN 16
Minimal Efficiency	75%
Casing (wetted part) MOC	SS316L
Impeller Type	Closed
Impeller MOC	SS316L
Shaft/Sleeve MOC	SS316L
Wear Ring MOC	SS316L
Bearings Lubrication	Grease
Mechanical Seal	Single, Silicon/Silicon Spring – Hastelloy C Elastomer – Viton Screws – SS316L
O-ring MOC	PTFE
Base Plate MOC	Cast Iron
Base Plate Coating	Roasted Epoxy
Coupling	Elastomer with spacer
Motor	See Section B.1.16 below

Parameter	Details
Pump Tag Name	**P-110A/B/C**
Type	Submersible
Flanges Standard	ISO/DIN PN 16
Duty Flow Rate	150 m^3/hr
Minimal Efficiency	75%
Impeller Type	Closed
Casing MOC	SS316L
Impeller MOC	SS316L
Shaft/Sleeve MOC	SS316L
Wear Ring MOC	SS316L
Bearings Lubrication	Grease
Mechanical Seal	Single, Silicon/Silicon Spring – Hastelloy C Elastomer – Viton Screws – SS316L
O-ring MOC	Viton
Coupling	Elastomer with spacer

Parameter	Details
Motor Protection	See Section B.1.16 below
Motor Cooling Method	Surface cooling
Required Accessories	1. Base for the pump 2. Discharge elbow 3. Upper guide holder 4. Water sensor in the oil bath 5. Temp. switch for the motor

Information to be submitted with proposal:

- Pumps' manufacturer.
- Pumps' performance curve.
- Pumps' stable operating range.
- Pumps' efficiency over the flow range.
- Pumps' mechanical seal Supplier and construction details.
- Supplier of the couplings.
- Pumps' construction materials of the different components.
- Sectional drawing of the pump
- Certificate of performance testing, signed by the manufacturer. The performance test shall include inter alia, certified performance curve, of flow versus head, efficiency and power consumption.

B.1.15. Electrical Motors for Pumps

All motors shall be TEFC (totally enclosed fan cooled) type.

The motor power shall be sized to be at least 115% of the rated power at the duty point. It shall be three-phase asynchronous, squirrel cage, protection class: IP54 for horizontal centrifugal pumps and IP68 for submersible pumps, VPI impregnation, SF (Service Factor) 1.15, Insulation class F, temperature rise class B, for ambient temperature of 45^0C. Voltage 400V, 50 Hz, RPM of up to 1,500.

B.1.16. Chemical Dosing Systems

- **General**
  - Chemical injection skids shall be supplied as a plug&play unit on a polyethylene board with adequate support to prevent deflection or warping. The complete unit shall be water and pressure tested.

- Equipment shall be assembled by a manufacturer with a proven history building similar type packages with a certified Quality Assurance system.

- **Dosing Pumps**
  - The required quantity and flow rate (where applicable) of dosing pumps per dosing skid is specified in section B.1.7.
  - The materials of construction of each dosing pump shall be compatible to the chemical being pumped.
  - All dosing pumps shall have a Profibus DP communication protocol. The profibus network shall be connected to an interface unit (such as CIU 150 by Grundfos) to protect the profibus cable from any damage by the chemicals.

- **Appurtenances**
  - The dosing skids shall be equipped with the following appurtenances:
    - Back pressure valve, pre-mounted, with true union connections for easy removal and repair.
    - Pressure relief valve, one per pump.
    - Pressure gauge, with diaphragm isolators.
    - Pulsation Damper.
    - Calibration column - shall be sized for a minimum 30 second draw down and shall be self-filling from the bottom of the column.
    - Injection valve (to be installed at injection point).
    - Float switch (to be installed in dosing tank).
  - The diameter of interconnecting piping between appurtenances shall be recommended by the pump Supplier and not be less than the standard pumps' inlet and outlet diameter. Connections shall be solvent welded or union to prevent the presence of threaded fittings.
  - Interconnecting piping, except NaOH, shall be HDPE or PVC[6]. Seal materials shall be compatible with the chemical being pumped.
  - Interconnecting piping for NaOH shall be PVDF or PP[6]. Seal materials shall be compatible with the chemical being pumped.

[6] Notification notice no.7 item(d)2

- Isolation valves shall be true union three-piece design or equivalent. Valves on sodium hypochlorite service shall be vented to prevent the accumulation of gas in the system.
- Solvent used in the fabrication process for all piping joints shall be compatible with the chemical being pumped.

B.1.17. Mixers

- The following mixers shall be supplied and installed:
  - Flash Mixing Tank – 1 unit.
  - Flocculation tanks – a total of 3 units – 1 per tank.
- Supply all mixers according to the following requirements:

Parameter	Details
Mixer Tag Name	M-100
Type	Top-Mounted
Wetted Parts	SS316LSS316L
Mounting	Base plate
Rotations	1,000-1,500 RPM
Motor	See MWC Standard Specification for vertical electric motors 614.002
Gear	Heavy duty, parallel shaft design. Single housing for double and triple reduction. Drive efficiency to be greater than 95%. Output shaft bearing min life of 100,000 hours.
Gear Lubrication	"Fail safe" oil splash type lubrication.
Standard features	Vertical motor, flexible coupling with approved steel guards, parallel gear reducer, specified shaft & turbine assembly.

Parameter	Details
Mixer Tag Name	M-101A/B/C
Type	Top-Mounted
Wetted Parts	SS316LSS316L
Mounting	Base plate
G Value	20-50 s^{-1}
Motor	See MWC Standard Specification for vertical electric motors 614.002

Parameter	Details
Gear	Heavy duty, parallel shaft design. Single housing for double and triple reduction. Drive efficiency to be greater than 95%. Output shaft bearing min life of 100,000 hours.
Gear Lubrication	"Fail safe" oil splash type lubrication.
Standard features	Vertical motor, flexible coupling with approved steel guards, parallel gear reducer, specified shaft & turbine assembly.

B.1.18. Air Scour Blowers

- 4 UF air scour blowers (3+1) shall be designed, supplied and installed.
- All blowers shall comply with the following specification:

Parameter	Details
Type	Positive Displacement Rotary Lobe with 3 lobes
Connections	Flange flexible connection.
Shaft	Cast Iron
Lobes	Cast Iron
Drive	V-Belt Drive
Guard	Perforated Plate V-belt drive guard
Motor	• According to MWC standard specification 611.011. • TEFC, Foot Mounted IE3 Standard. • 1,500 RPM. • Inverter-duty rated. • Motor shall be suitable to operate with VFD. • Shall include PTC.
Accessories (all integrated on local package)	Discharge Check Valves (Flapper Type), Air Intake Filter/Silencer, Discharge Silencer, Pressure Relief Valve, Discharge Pressure Gauge, Discharge temperature switch on air line, Enclosure temperature switch, Acoustic enclosure.
Sound Pressure Level	According to ISO 3740:2019

Blower Package shall include:

- One (1) complete set of any special tools required to maintain the positive displacement blower(s) (one set of tools per blower).
- Factory test report, including Test Data Sheets and confirmation of blower curve performance.
- An acoustic sound enclosure for each blower as required. Enclosure to remove package heat by means of a mechanical fan.

B.1.19. Instrument Air Compressor System

An air compressor system shall be supplied to provide compressed air to the pneumatic valve actuators and for instruments

The air compressor shall be design to comply with the following specifications:

Parameter	Details
Type	Reciprocating Compressor
Maximum Pressure	Up to 10 barg
Redundancy	1+1 reciprocating units shall be designed per one air receiver.
Cooling	Belt driven air cooled after-cooler for oil cooling and fan for casing cooling.
Max Sound Pressure Level	80 dB (A) – per ISO 2151
Drive	Belt driven; c/w belt guard.
Motor	TEFC EPACT IE3 at least 3,000 RPM For a motor greater than 7.5 kW, a control cabinet with star-delta protection shall be provided.
Accessories	Sound enclosure, pressure gauge, pressure relief valve, shut-off valve, enclosed belt guard, oil filter, oil vent, oil drain plug and oil level sight glass, IP55 dual contact pressure switch and inlet filter with silencer.

The compressors' air receiver shall be furnished based on the following specification:

Parameter	Details
Receiver Tank	Vertical or horizontal, painted carbon steel.
Receiver Tank Volume	Based on the entire WTP pressurized air requirements – shall be determined by the Supplier.
MOC	Carbon Steel

Accessories	electronic condensate drain, discharge isolation valve, pressure gauge, pressure relief valve, anti-vibration mounts between air receiver and the floor.

The compressed air system shall also include an air drier to be furnished based on the following specification:

Parameter	Details
Air Dryer Type	Refrigerated air dryer
Due Point	3°C
Correction Factor	Shall be designed according to inlet pressure and ambient temperature.
Accessories	Auto drain, condensing unit, refrigerant evaporator, mechanical separator, automatic condensate discharge valve, high discharge air temperature alarm light, pre-filter (1 µm with automatic drain and differential pressure indication for particles removal) and after-filter (0.1 µm with differential pressure indication), activated carbon filter for oil aerosols removal.

B.1.20. **Sluice Gates**

- 1 electrically operated weir gate shall be supplied and installed per each flocculation tank. The three (3) gates shall be installed at the overflow from the distribution channel to the flocculation tanks.
- The weir gates shall comply with the following specifications:

Parameter	Details
Type	Channel weir gate
Operation	Gear
Frame MOC	SS316
Shutter MOC	SS316
Seal MOC	EPDM
Stem / Spindle MOC	SS316
Motor	See MWC standard specification for vertical electric motors 614.002[7]

[7] Clarification notice no.4 annex B item 12

B.1.21. Valves and Actuators

B.1.21.1. Valve Requirements

- All valves shall have ISO/DIN standard flange connection.
- Mark valves with size, pressure rating and Supplier on a corrosion resistant nameplate mounted on the body.

B.1.21.2. Valve Actuators

- Supply actuators only for the marked valves in the attached PFD drawings (Appendix 2).
- Supply removable lever handles (1/4 turn type) for valves equal to, or smaller than 150 mm. Provide a chain operated geared hand wheel operator for all gate and butterfly valves mounted equal to, or greater than 1700 mm above the floor regardless of size.
- Provide gear actuated hand wheels for all valves equal to or greater than or 200 mm regardless of type.
- Ensure that each valve and operator is of suitable construction and rating for the long-term service with the fluid or product being conveyed and at the pressure and operating frequencies required by the relevant service.
- The allowable pull on a manual operator to open or close the valve shall be less than or equal to 270 N. Manual operators shall operate in a clockwise motion to close the valve.
- Supply cast iron hand wheels clearly marked with a flow directional arrow and the word "open" cast in relief on the rim. Provide hand wheels greater than 300 mm in diameter for all valves greater than 200 mm and 450 mm diameter for larger valves as required to allow for manual operation.
- Supply steel pipe Tee wrenches with socket to suit nut dimensions. In cases of valves in tanks requiring extension stems and Tee wrenches, the wrench is to be secured in place.
- Furnish chain operators where required. They shall consist of cast iron chain wheels with chain guide and zinc coated chain. Provide means, by split pins or other locking devices, to positively prevent the chains or wheels coming off the shaft.

B.1.21.3. Electrical Actuators

- Electric valve actuators shall be modulating electric direct drive rated for 1,200 starts per hour, quarter-turn.

- Supply electrical actuators for marked valves (PFD in Appendix 2) with a diameter equal or greater than DN250 (or 10").
- All electrical actuators shall be equipped with limit switches with SPDT communication and enclosure protection of IP65.
- Size actuators to provide sufficient torque to operate the control valves at differential pressures across the closed valve equivalent to the maximum valve pressure rating specified. Such differential pressure shall be applied in either direction.
- The actuators shall be complete with a hand wheel and lockable lever for hand wheel engagement.
- The actuators shall be 400 V 3-Ph 50 Hz as required.
- The actuator enclosures shall be NEMA 4 rated for typical applications.
- The control system shall include but not necessarily be limited to the following:
  - In remote mode the valve shall be opened and closed by Profibus DP protocol.
  - Supply each actuator with a separate sealed terminal compartment.
  - The valve and actuator mounting bracket shall withstand the stall torque of actuator with torque and limit switches disconnected.

B.1.21.4. Pneumatic Actuators

- Supply pneumatic actuators for marked valves (PFD on Appendix 2) with a diameter of less than DN250 (or 10").
- The pneumatic actuators shall be designed with the following specs:

Parameter	Details
Type	Single acting (air to spring)
Valve Type	Butterfly valves
Body Material	Extruded Aluminum Alloy, Anodized
Travel Stop	Alloyed Steel
End Caps	Die Cast Aluminum Alloy
Pistons	Die Cast Aluminum Alloy
Output Shaft	Carbon Steel (Zinc Plated)
Shaft Bearings	Acetal
Fasteners	Stainless Steel
Limit Switches	For all pneumatic actuated valves
Additional Features	Open and closing speed control
Position Control	Profibus DP

Parameter	Details
Type	Single acting (air to spring)
Service	Chemical lines
Valve Type	Ball valves
Body Material	Glass Filled PP or Aluminum
End Caps	Glass Filled PP or Aluminum
Pistons	Die Cast Aluminum Alloy
Output Shaft	SS316L
Fasteners	SS316L
'O' rings	Nitrile
Position Control	Profibus DP

B.1.21.5. Butterfly Valves

Parameter	Details
Type and Diameter	Butterfly Valves DN80 to DN800
Service	Air
Style	Wafer
Pressure Rating	ANSI 150 or DIN PN16
Body	Carbon Steel
Disc	SS316L
Shaft	SS316L
Seat	EPDM
Manual Operator	Gear

Parameter	Details
Type	Butterfly Valves DN80 to DN800
Service	Pre-filtration, final UF product lines and UF backwash lines (no or minor chemical lines).
Style	Wafer
Pressure Rating	ANSI 150 or DIN PN16
Actuator Mounting (actuated valves only)	DIN/ISO 5211
Body	Carbon Steel
Disc	Carbon Steel

Shaft	Carbon Steel or stainless steel[8], dry shaft design, split shaft pin-less design
Seat	EPDM
Manual Operators	Manual or Electrical Actuated Valves – Gear Pneumatic Actuated Valves - Lever

Parameter	Details
Type	Butterfly Valves DN80 to DN800
Service	UF membranes feed lines and CIP lines
Style	Wafer
Pressure Rating	ANSI 150 or DIN PN16
Actuator Mounting (actuated valves only)	DIN/ISO 5211
Body	Carbon Steel
Disc	Super Duplex
Shaft	Super Duplex, dry shaft design, split shaft pin-less design
Seat	PTFE
Manual Operators	Manual or Electrical Actuated Valves – Gear Pneumatic Actuated Valves - Lever

B.1.22. Control System and Instrumentation

B.1.22.1. Control System

The control system shall allow for complete automation of the system.

The control and the supervision of the plant shall be done both from the plant's control room and from the remote-control room in Ramle. Consequently, all the required final control elements such as control valves, dosing pumps, or frequency converters shall be fully automatic, wired to the PLC.

B.1.22.2. HMI and PLC Equipment – Designed and Supplied by MWC

- The basic control architecture of the YTF is detailed below and displayed in the attached Appendix 5 (two drawings).
- There are Four (4) Command Cabinets (CCs), controlling three systems throughout the YTF:

[8] Notification notice no.7 item (d)1

- The IWDP – marked as A01.
- The WTP – marked as A02.
- The ferric chloride and sodium hypochlorite dosing stations – marked as A03.
- The SMPS – marked as A04

- The first three CCs are inter-connected by an Ethernet line.
- Each of the first three CCs shall include: PLC (GE RX3i), computer, HMI and ACE controller.
- The A04 CC is connected to all other CCs by a radio communication.
- The first three CCs are designed to operate with Profibus DP communication protocol.
- The control of Profibus system will be carried out by "COMBRIX" bouncing device.
- Starters are controlled by "TURCK" I/O modules at power cabinet.
- The communication with VFDs are through Profibus built-in card.
- The on/off valves of the pre-filtration system shall be connected to a FESTO solenoid block.
- The on/off valves of each UF line shall be connected to a separate FESTO solenoid & I/O block.

B.1.22.3. Field Instruments

This section refers to the field devices used to monitor and control the WTP process.

The following transmitting field instruments shall be supplied with Profibus DP communications port: electromagnetic flow meters, level transmitters, turbidity transmitters, pH transmitters, free chlorine analyzers, conductivity transmitters and temperature transmitters.

B.1.22.3.1. Flow Transmitters

- The following flow transmitters shall be supply and installed:
  1. On the discharge line of each permeate pump – 6 units total.
  2. On the discharge line of the UF backwash pump – 1 unit.
  3. On the discharge line of the reject discharge pump – 1 unit.

- Each flow transmitter shall comply with the following specification:

Parameter	Details
Type	Electromagnetic, remote version

Parameter	Details
Process Connections	ISO/DIN standard flange connection.
Accuracy	± 0.25% of reading at 0.5-10 m/s at reference conditions
Precision	± 0.1% of full scale
Housing	Steel, full welded
Flow Tube	SS316LSS316L
Liner	Hard Rubber
Protection Class	IP 67 (at least)
Display	Lighted LCD, indication of flow rate and totalizer, vertical position
Output signal	Profibus DP
Power	230 VAC
Transmitter Housing	Cast Aluminum

B.1.22.3.2. Level Transmitters

- The following level transmitters shall be supplied and installed:
  1. A DP level transmitter in the pre-filtration backwash tank – 1 unit.
  2. A submerged hydrostatic level transmitter in each UF membrane tank – 6 units total.
  3. A Laser level transmitter in the UF backwash tank – 1 unit.
  4. A Laser level transmitter in each CIP tank – 2 units total.
  5. A submerged hydrostatic level transmitter in the reject pumping station – 1unit.
  6. A DP level transmitter in the hypochlorite storage tank – 1 unit.
  7. A DP level transmitter in the ferric chloride storage tank – 1 unit.

- Each of the abovementioned laser level transmitters shall comply with the following specification:

Parameter	Details
Type	Laser
Process Connections	ISO/DIN standard flange connection.
Measuring Range	0-4 m
Housing	Steel, full welded
Accuracy	± 0.5%
Integral LCD	Yes
Protection Class	IP 67 (at least)
Output signal	Profibus DP

Parameter	Details
Power	230 VAC

- Each of the abovementioned DP level transmitters shall comply with the following specification:

Parameter	Details
Type	Hydrostatic (DP)
Process Connections	ISO/DIN standard flange connection.
Measuring Range	0-3 m
Accuracy	± 0.1% of full scale
Precision	± 0.05% for five years
Housing	Steel, full welded
Diaphragm	Hastelloy C with PTFE seal
Integral LCD	Yes
Protection Class	IP 67 (at least)
Output signal	Profibus DP
Power	230 VAC

- Each of the abovementioned submerged hydrostatic level transmitters shall comply with the following specification:

Parameter	Details
Type	Hydrostatic (immersed)
Process Connections	DIN standard flange connection
Measuring Range	0-4 m
Accuracy	± 0.25% of full scale
Precision	± 0.05% for five years
Body	PVDF
Seal	EPDM
Measuring Element	Ceramic cell
Integral LCD	Yes
Protection Class	IP 67 (at least)
Output signal	Profibus DP
Power	230 VAC

B.1.22.3.3. Pressure Transmitters

- One pressure transmitter shall be supplied and installed on the permeate intake line of each UF train – a total of 6 transmitters shall be supplied.
- Each pressure transmitter shall comply with the following specification:

Parameter	Details
Type	Internal Diaphragm
Process Connections	DIN standard flange connection
Measuring Range	-1.2 to +1.2 m
Accuracy	± 0.2% of full scale
Body MOC	SS316LSS316L
Wetted Parts MOC	SS316LSS316L
Diaphragm MOC	Ceramic
Integral LCD	Yes
Protection Class	IP 66 (at least)
Output signal	Profibus DP
Power	230 VAC

B.1.22.3.4. Temperature Transmitters

- One temperature transmitter shall be supplied and installed on the permeate collection header of the UF system.
- The temperature transmitter shall comply with the following specification:

Parameter	Details
Type	RTD
Process Connections	DIN standard flange connection
Measuring Range	0 - 100°C
Accuracy	± 0.1% of full scale
Integral LCD	Yes
Protection Class	IP 66 (at least)
Output signal	Profibus DP
Power	230 VAC

B.1.22.3.5. Turbidity Transmitters

- Two types of turbidity transmitters shall be designed:
  1. High turbidity range – one on the raw water line and the second on the flocculated water line – A total of two units shall be supplied and installed.
  2. Low turbidity range – one turbidity transmitter on the permeate intake line of each UF train - A total of 6 units shall be supplied and installed.

- The high range turbidity transmitters shall comply with the following specification:

Parameter	Details
Type	Optical sensor – scattered light method
Mounting	the sensor is mounted on the sampled line
Range	0.5-1,000 NTU
Response Time	<1.5 min
Accuracy	± 5% of reading or ± 0.1% NTU
Precision	± 0.01 NTU
Sensor Cleaning	in place by compressed air
Protection Class	IP 68 (at least)
Output signal	Profibus DP
Power	230 VAC

- The low range turbidity transmitters shall comply with the following specification:

Parameter	Details
Type	Optical sensor – scattered light method
Mounting	Self sampling sensor - Indoor
Range	0.01-10 NTU
Response Time	<1.5 min
Accuracy	± 2% of reading or ± 0.02% NTU
Precision	± 0.01 NTU
Sensor Cleaning	Automatic
Protection Class	IP 66 (at least)

Parameter	Details
Output signal	Profibus DP
Power	230 VAC
Accessories	Integral automatic bubble/air release for each unit, one on-site calibration kit, one maintenance kit.

B.1.22.3.6. pH Transmitters

- The following pH transmitters shall be supplied and installed:
  1. On the raw water line – 1 unit.
  2. In the Rapid Mix Tank – 1 unit.
  3. On the acidic CIP discharge line – 1 unit.
  4. On the hypo CIP discharge line – 1 unit.

- Each pH transmitter shall comply with the following specification:

Parameter	Details
Measuring Method	Differential electrode measurement technique
Range	0-14
Cycle Time	<0.5 min
Accuracy	± 5% of reading
Precision	± 1%
Temperature Compensation	yes
Output signal	Profibus DP
Power	230 VAC (50 Hz)
Calibration	In place, 2 point calibration
Protection	IP65 (at least)
Display	LCD
Accessories	One on-site calibration kit, one maintenance kit.

B.1.22.3.7. Total Chlorine Analyzer

- The following total chlorine analyzers shall be supplied:
  1. On the hypo CIP discharge line – 1 unit.

2. On the chlorination tank – 1 unit.
3. On the supplied water line to the park (post-chlorination) – 1 unit.

- Each total chlorine analyzer shall comply with the following specification:

Parameter	Details
Measuring Method	Colorimetric/ Photometric
Range	0-5 mg/l as Cl_2
Accuracy	± 5% of reading or ± 0.03 mg/l
Cycle Time	<3 min
Output signal	Profibus DP
Power	230 VAC, 50Hz
Calibration	In place, 2 point calibration
Protection	IP65 (at least)
Display	LCD
Installation	Indoor
Accessories	One on-site calibration kit, one maintenance kit.

B.1.22.3.8. Conductivity Transmitters

- One conductivity transmitter shall be supplied and installed on the raw water line to the WTP.

- The temperature transmitter shall comply with the following specification:

Parameter	Details
Measuring Method	Conductive principle
Range	50 – 5,000 µS/cm
Accuracy	± 2% of reading
Cycle Time	<1 min
Output signal	Profibus DP
Power	230 VAC, 50Hz
Calibration	In place
Protection	IP65 (at least)

Parameter	Details
Display	LCD
Installation	Indoor
Accessories	One on-site calibration kit, one maintenance kit.

B.1.22.3.9. Level Switches

- Type: Conductivity electrode.

B.1.22.3.10. Pressure Gauges

- Pressure gauge shall be liquid filled and are Wika with 316SS wetted parts.
- Supply each pressure gauge c/w isolation ball valve to be installed between the pressure gauge and the process line.
- Provide diaphragm seal between gauge and isolation valve on all water lines.

B.1.23. Operation Training Services

All under the responsibility of the Supplier.

- The Membrane System Supplier shall provide classroom and field training to the MWC's supervisory, operation and maintenance personnel covering the operation and maintenance of the WTP.
- General requirements of the training follow:
    - The first training session will occur during the commissioning and consists of two (2) days.
    - The scope of the training shall include sufficient information for the operational personnel such that they can successfully operate the WTP without the supervision of the Membrane System Supplier.
    - A minimum of 1 day of the total training time shall be suited for the maintenance staff.
    - Training shall cover safety issues related to the Membrane System and removal, cleaning (CIP) and replacement of membrane units.
- Include cost of all wages, taxes, benefits, insurance, travel and living expenses associated with the training services in the Bid Price.
- Provide to MWC, in writing, at least 30 days before Substantial Completion of the project and at least 21 days before the training session, a training schedule, course outline and curriculum for review and acceptance by MWC.

B.1.24. Commissioning

Requirements for performance during the pre-startup, startup, cold and hot commissioning of the equipment supplied under this contract.

B.1.24.1. Key Members

The Supplier shall comply with all requirements relating to Key Members including with regard to their experience and qualifications, nomination, tenure, activities and on-site attendance, all as provided*, inter alia,* under sections 20 and 21 of **Volume 2** *(Contract)*.

Commissioning Schedule With regard to the "Commissioning" stage the Supplier shall address in detail, at least, the following activities and stages:

1. Name of the task
2. Duration of each task
3. Predecessors that must happen prior to the task
4. Resources required for each task
5. Planning requirements to be outlined.
6. Execution time

B.1.24.2. Equipment Delivery Inspection

Provide a site representative to supervise off loading and storage of the equipment.

Verify with MWC that all equipment was received as per packing list and that all equipment was received in good condition. Any equipment damaged during shipment will be noted and photographed for follow up on getting corrected.

B.1.24.3. Commissioning Site Assessment

Supplier’s Startup & Commissioning Engineer will perform a site review of all equipment installation. This review shall consist of, at least:

- As-built P&ID review.
- Piping & Equipment installation review.
- Review onsite issues with MWC, for example:
  1. Installation questions.
  2. Identification of components.
  3. Help locate or source missing parts.
  4. Review any concerns with installation and provide recommendations.
- Generate deficiency lists for MWC.
- Review with MWC personnel all onsite commissioning activities and identify the required resources for each task.

- Participate in the FAT (Factory Acceptance Test) of the control software, conducted by MWC.

Any additional or deriving review item MWC may require.

B.1.24.4. Cold Commissioning with Tap Water

- Cold commissioning entails the operation of the WTP with Tap Water, supplied at TP2.
- Supplier shall inspect all the equipment prior to startup for apparent installation defects or substandard workmanship.
- Supplier shall provide written acceptance of installation prior to startup.
- Participate in the Check & Verify process for each control loop, conducted by MWC.
- Inspect and ensure that all instrumentation has been calibrated.
- Conduct start-up tests in conjunction with MWC.
- Potable water shall be used for the commissioning.
- Deficiencies that are uncovered shall be corrected and retesting shall be conducted as required.
- The membrane tanks shall be filled with tap water and the Supplier shall be required to demonstrate its operation to MWC. The demonstration shall include the witnessing of all set points, control features and alarms associated with the system.
- Emergency shutdowns, simulated power failures and other failures shall be tested and demonstrated in accordance with the intent of the design criteria.
- Each membrane tank shall be operated individually to simulate high and low flow conditions and demonstrate that the membranes are able to supply water at the desired flowrate.

Any additional or deriving review item MWC may require.

B.1.24.5. Hot Commissioning with River Water

- Hot commissioning entails the operation of the WTP with Yarkon river water.
- During the Hot Commissioning, which shall be conducted for a period of one (1) month, the WTP shall be tested for compliance with Tables 1 and 5.

B.1.24.6. Commissioning Completion

Once MWC's approves all Commissioning activities and stages were completed per the requirements of this **Volume 3** (SOW) – MWC shall issue, per the Supplier's request, a

certificate testifying of the Commissioning completion ("**Commissioning Completion Certificate**").

B.1.25. 1st Performance Test

- Commencement of the 1st Performance Test is subject to MWC's issuance of the Commissioning Completion Certificate.
- The performance test shall be conducted for five (5) business days starting from Sunday till Thursday.
- A total of three (3) grab samples of final product water shall be taken by a certified sampler – each sample in a pre-selected day during work hours. All analytical testing shall be performed at a certified laboratory acceptable to MWC. Preserve and analyze in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater".
- A net flux (for the UF membranes) and total plant recovery shall be calculated each day for compliance with the values stipulated in Table 5.
- During the Performance Test the Supplier shall supervise and guide MWC in its operation of the WTP.

B.1.26. Warranty Period Services

The following Requirements for the provision of post-commissioning services are specified in this section with the following break-down will be part of the Supplier scope:

1. Routine performance tests during the first year of continuous operation.
2. Technical Support
3. First Year Service Plan.

B.1.26.1. Technical Support

- Provide telephone and e-mail access to experienced technical support specialists during standard business hours.
- Maintain plant documentation using an information system that ensures the technical support team has access to plant drawings as well as control logic and operational sequence charts.
- Provide specialized process support for troubleshooting post-commissioning process issues.

B.1.26.2. On Site Support

Provide access to a service team which can deliver on any of the following scope of service components on a scheduled or unscheduled, emergency basis.

- Membrane inspection.
- Membrane maintenance, exchange or upgrade.
- Controls trouble-shooting, optimization or upgrade.
- Process support plant checkup/plant audit.
- Preventative maintenance planning.
- System or plant upgrade.
- Classroom and hands-on new operator training or refresher training.

B.1.26.3. First Year Service Plan

- Provide a comprehensive service plan for the first year of plant operation. First year service plan shall include the following components:
  1. 24/7 Emergency Telephone Technical Support.
  2. Complete Process Monitoring service.
- Provide guidance on membrane inspection procedures and optimization assistance, performing the first membrane recovery cleaning, refresher training, etc.

B.1.27. Miscellaneous

B.1.27.1. Equipment Marking

All plant equipment will be provided with labels, and the original Suppliers' nameplate will be maintained.

The label shall contain: Tag No., Short description, and the Physical data such as pressure temperature etc. The data shall be written in black letters over a polished SS plate.

B.1.27.2. Quality Assurance and Testing

Supplier shall ensure that a proper quality assurance procedure will be applied for the supplied equipment.

Test certificates, reports, calculations, quality control procedures, and any other document as deemed required by the director, shall be submitted to the MWC.

The aforesaid submittal shall be within one week from the written demand by the Director.

B.1.28. Applicable Standards

The following are the applicable standards and codes:

- ASME – American Society of Mechanical Engineers
- ANSI – American National Standards Institutes
- IEC – International Electrotechnical Commission
- ASTM – American Society for Testing and Materials
- AWWA – American Water Works Association
- NEMA – National Electrical Suppliers Association
- IEEE – Institute of Electrical and Electronics Engineers
- ISA – International Society of Automation
- ISO – International Organization of Standardization
- SII – Standards Institute of Israel
- Any other relevant standard.

The WTP design shall comply with the Israeli standards and regulations.

In case of absent Israeli standard, the design shall comply with the European or American standard.

In any case of contradiction between various standards, thee more stringent standard should be applied.